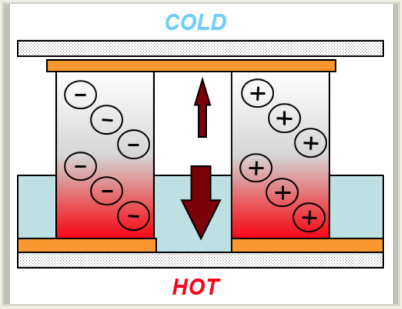
Asymmetric Conductance Thermoelectric Cooling Modules for Cryogenic Applications, Phase I

Completed Technology Project (2017 - 2017)

Project Introduction

Thermoelectric coolers (TECs) have long been noted for their compact construction, high reliability, and clean, quiet operation, and they are now widely used in consumer products. However, TECs are inefficient devices requiring large electrical currents to provide a refrigerant effect. Even modest improvements in TEC performance would vastly increase the market potential of thermoelectric cooling, expanding its role into maintaining space science instrument components at cryogenic temperatures (<90K), as well as increasing adoption in consumer appliances such as refrigerators and air conditioners. microVection has identified a means of improving the efficiencies of TECs with minor design and fabrication changes. This involves shifting the peak temperature location through modification of the conductance in a simple and controlled manner. This was demonstrated first analytically and then by using a small cell of 3 couples (6 legs), and the results showed a significant (~30%) increase in the temperature differential of the cell at no heat load. The simplicity of the concept suggests that it offers a near-term, affordable cooling solution that can take advantage of both advanced materials and reductions in scale to improve temperature differentials by as much as 30%. Conversely, the same temperature differential can be achieved at lower input power levels, or at higher cold-side heat fluxes, with input power being reduced by as much as 60%. The overarching goal of the proposed effort is to bring high-performance thermoelectric cooling technology to a maturity suitable for the space science and commercial marketplaces, and to demonstrate analytically and experimentally that asymmetric conductance TEC designs offer significant advantages over conventional thermoelectric devices. The specific objective of the Phase I is to show that asymmetric conductance thermoelectric devices offer near-term improvements to thermoelectric coolers in high current design scenarios.



Asymmetric Conductance Thermoelectric Cooling Modules for Cryogenic Applications, Phase I Briefing Chart Image

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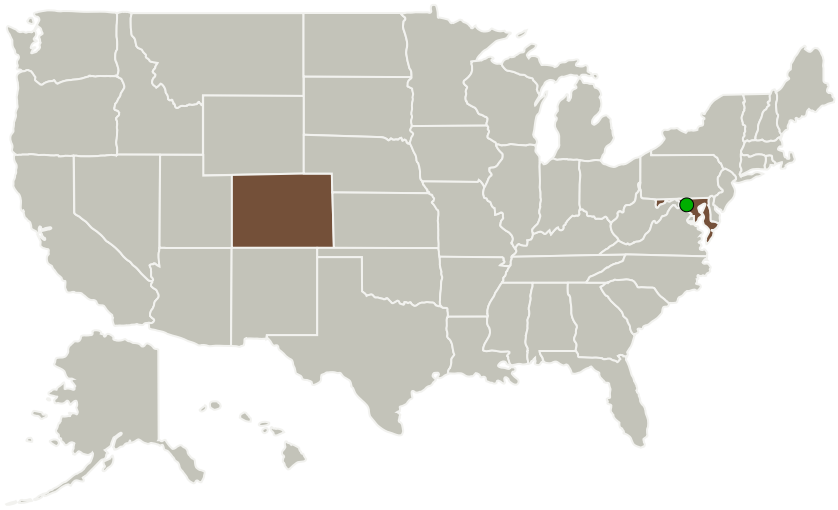
Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
microVection, Inc.	Lead Organization	Industry	Broomfield, Colorado
Goddard Space Flight Center(GSFC)	Supporting Organization	NASA Center	Greenbelt, Maryland

Primary U.S. Work Locations	
Colorado	Maryland

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Organization:

microVection, Inc.

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

Project Management

Program Director:

Jason L Kessler

Program Manager:

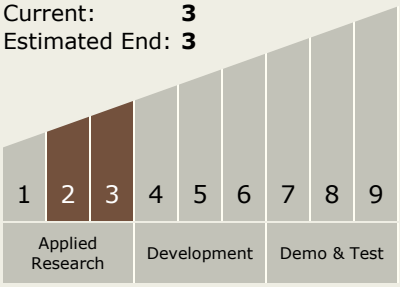
Carlos Torrez

Principal Investigator:

Geoffrey Campbell

Technology Maturity (TRL)

Start: **2**
Current: **3**
Estimated End: **3**



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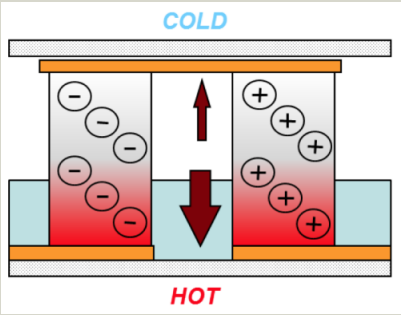
Images



Briefing Chart Image
Asymmetric Conductance Thermoelectric Cooling Modules for Cryogenic Applications, Phase I Briefing Chart Image *(https://techport.nasa.gov/image/131386)*

Technology Areas

Primary:

- TX14 Thermal Management Systems
  - TX14.2 Thermal Control Components and Systems
    - TX14.2.2 Heat Transport

Target Destinations

The Sun, Earth, The Moon, Mars, Others Inside the Solar System, Outside the Solar System